

# Raphaël Bulle

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Currently **post-doctoral researcher at GIREF** (Laval University, CA) working on gradient reconstructions in the context of multimaterial finite element simulations in collaboration with Michelin.

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## Research interests

Finite element methods    Error estimation    Adaptive methods    Fractional PDEs  
FEniCSx software    Linear poroelasticity    Stochastic PDEs    Multi-level Monte Carlo methods

## Education

2022	<b>PhD</b> in Engineering sciences and Mathematics Thesis supervised by S. P. A. Bordas, F. Chouly, J. S. Hale, A. Lozinski	Univ. Luxembourg & Univ. Franche-Comté (FR)
2017	<b>Master's degree</b> Advanced Mathematics	Univ. Franche-Comté
2016	<b>Agrégation externe de Mathématiques</b> competitive exam	National (FR)
2015	<b>Master's degree</b> Mathematics instruction	Univ. Franche-Comté
2014	<b>CAPES de Mathématiques</b> competitive exam	National (FR)
2013	<b>Bachelor's degree</b> Mathematics	Univ. Franche-Comté

## Publications

- Ongoing *A multi-mesh finite element discretization fo the spectral fractional power of the Laplacian*  
A. Bespalov, **R. Bulle**
- 2023 *An a posteriori error estimator for the spectral fractional power of the Laplacian*  
**R. Bulle**, O. Barrera, S.P.A. Bordas, F. Chouly, J.S. Hale, *Computer Methods in Applied Mechanics and Engineering*, doi.org/10.1016/j.cma.2023.115943
- 2023 *Hierarchical a posteriori error estimation of Bank-Weiser type in the FEniCS project*  
**R. Bulle**, J.S. Hale, A. Lozinski, S.P.A. Bordas, F. Chouly, *Computers & Mathematics with Applications*, doi.org/10.1016/j.camwa.2022.11.009
- 2021 *The human meniscus behaves as a functionally graded fractional porous medium*  
**R. Bulle**, G. Alotta, G. Marchiori, M. Berni, N. F. Lopomo, S. Zaffagnini, S. P. A. Bordas, O. Barrera, *Applied Sciences*, doi:10.3390/app11209405
- 2020 *Removing the saturation assumption in Bank-Weiser error estimator analysis in dimension three*  
**R. Bulle**, F. Chouly, J. S. Hale, A. Lozinski, *Applied Mathematics Letters*, doi:10.1016/j.aml.2020.106429

## Software

- 2022 *FEniCSx–Error–Estimation*, a FEniCSx package for a posteriori error estimation  
**R. Bulle**, J. S. Hale, git repository:  
github.com/jhale/fenicsx-error-estimation  
LGPLv3

## Conference presentations and posters

- 2023 *An a Posteriori Error Estimator for the Spectral Fractional Power of the Laplacian* (invited by Prof. S. Harizanov)  
**R. Bulle**, O. Barrera, S. P. A. Bordas, F. Chouly, J. S. Hale  
LSSC 2023
- 2021 *Local a posteriori error estimates for the spectral fractional Laplacian*  
**R. Bulle**, S. P. A. Bordas, F. Chouly, J. S. Hale, A. Lozinski  
FEniCS conference
- 2021 *Practical aspects of a hierarchical a posteriori error estimator of Bank–Weiser type*  
**R. Bulle**, S. P. A. Bordas, J. S. Hale, F. Chouly, A. Lozinski  
SIAM CSE
- 2021 *A posteriori error estimation for the fractional Laplacian*  
**R. Bulle**, A. Lozinski, F. Chouly, S. P. A. Bordas, J. S. Hale,  
doi:10.13140/RG.2.2.10144.00006  
One Nonlocal World opening event
- 2020 *Practical aspects of the Bank–Weiser estimator implementation and biomechanics applications*  
**R. Bulle**, S. P. A. Bordas, J. S. Hale, F. Chouly, A. Lozinski  
WCCM ECCOMAS Congress

## Visiting researcher

- Sep. 2023 I have been invited by **Dr. Alex Bespalov** to work on a multi–mesh discretization of the spectral fractional Laplacian.  
University of Birmingham (UK)

## Invited seminars

- 2022 *A posteriori error estimation in the FEniCSx finite element software and application to the fractional Laplacian*  
**R. Bulle**, S. P. A. Bordas, F. Chouly, J. S. Hale, A. Lozinski  
Café technique Michelin, Clermont-Ferrand (FR)
- 2022 *Hierarchical a posteriori error estimation in the FEniCS finite element software and applications to fractional PDEs*  
**R. Bulle**, S. P. A. Bordas, J. S. Hale, F. Chouly, A. Lozinski  
GIREF seminar (Laval univ. CA)
- 2021 *Méthodes éléments finis et estimation d'erreur pour l'étude du ménisque*  
**R. Bulle**, S. P. A. Bordas, J. S. Hale, F. Chouly, A. Lozinski, O. Barrera  
Mini-conférence PASS-SPI
- 2021 *Discretization of the fractional Laplacian using finite element methods and a posteriori error estimation*  
**R. Bulle**, S. P. A. Bordas, J. S. Hale, F. Chouly, A. Lozinski  
PhD seminar (Univ. Franche-Comté)
- 2019 *Controlling error in multi–level approximations of stochastic PDEs*  
**R. Bulle**, F. Chouly, A. Lozinski, S.P.A. Bordas, J.S. Hale  
SPOC seminar (IMB Dijon, FR)

## Scientific organization

2021 **Minisymposium chairman** Advanced adaptive discretization methods SIAM CSE

## Teaching experience

2018 **Exercises in mathematics** 1st year of Engineering bachelor, one semester Univ. Luxembourg

2015 **Lecture & exercises of linear ODEs** 1st year of Biology bachelor, half of a semester Univ. Franche-Comté

2014 **Exercises of linear ODEs** 1st year of Biology bachelor, half of a semester Univ. Franche-Comté

## Technical skills

Python  
matlab

C++  
Git

LaTeX  
Docker, Podman

bash  
FEniCS, FreeFEM++